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COMMITTEE ON GAS

THE RATIONAL USE OF GAS IN THE VARIOUS SECTORS OF THE ECONOMY AND RELEVANT CONSERVATION ETHICS

(Consolidated report transmitted by the Government of USSR)

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At its twenty-second session, the Committee on Gas included in its programme of work 1/ the study of "The rational use of gas in various sectors of the economy, and relevant conservation ethics - methods of determining the efficiency of the use of gas in various branches of industry". The Group of Experts on the Use and Distribution of Gas carried out the study with the help of Mr N.A. Fedorov, government rapporteur from the USSR. At its eighth session, the Group approved 2/ the first report prepared by Mr Fedorov (ECE/GAS/36).

The study continued and further information collected provided the basis of a second report. The Group of Experts on the Use and Distribution of Gas, at its eleventh session, approved this second report and, in revising it, took into account certain modifications sent by the Government of Belgium and gave it general distribution. 3/

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1. This report has been prepared on the basis of information received from eighteen countries and of relevant sources in the literature.

2.1. World consumption of energy is constantly increasing: in 1950 it amounted to 2.852 billion TCE, in 1970 to 7.5 billion, and by 1980 it will increase to 11-12 billion TCE. It is to be expected that the rate of increase in energy consumption will be high in the coming decades [1, 2].

One of the major utilizable energy resources is natural gas. The share of this in the world energy balance is constantly increasing and now amounts to more than 20 per cent. It is expected that natural gas will play an important part in satisfying energy requirements until the end of the twentieth century [3, 4, 5].

1/ ECE/GAS/21, Annex I, project 07.2.1 (g).

2/ GAS/GE.2/10, para. 9 (b).

3/ GAS/GE.2/16, para. 15 (ii).

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2.2. Tables 1 and 2 give figures of natural gas consumption and a breakdown of it by various sectors of the economy in a number of countries. The tables show that:

Natural gas makes a very appreciable contribution to fuel and energy balances;

The bulk of the gas is used in industry (45-55 per cent) and for municipal and domestic purposes (10-34 per cent);

Natural gas is used in the most varied industrial processes. It has proved itself as a raw material in the chemical industry, also as a universal fuel (in metallurgy, mechanical engineering and metal working, the building materials industry, light industry, the food industry etc.), enabling highly economical technological solutions to be applied which make possible increase in the productivity of social labour, reduction in capital investments and production costs and abatement of air pollution.

2.3. The existing pattern of natural gas consumption has to a large extent been determined by the economic effect obtained.

Thus, natural gas has proved highly effective in the chemical industry (production of ammonia, methanol etc.) and has replaced solid fuel. It is 50 per cent cheaper to obtain ammonia from natural gas than from coal (Hungary, USSR etc.). Some 13 per cent of world output of natural gas is used in the chemical industry [23]. In the next ten years western European countries are expected to produce up to 300,000 tons of protein suitable for cattle feed [23].

Because gas may be effectively used as a process fuel for high-temperature processes (the melting and heating of metals, heat treatment of materials etc.) it has found widespread application in metallurgy, mechanical engineering and other branches of industry, thereby cutting down on the use of coke, low-sulphur fuel oil and other fuels.

The possibility of using natural gas for the production of highly effective reducing gases makes for highly efficient ore dressing and metal production.

3.1. The constantly increasing amount of energy consumed in the ECE region raises with increasing urgency the problem of rational use of fuels as economic resources and of their economical use to ensure the development of various sectors of the economy. This problem may be solved by reducing the energy consumption of technological processes and by accelerating technological progress in the saving of energy by means including the use of gas [17].

3.2. The rational and effective use of gas entails its use in an optimum balance in conjunction with other types of fuel and power in the main areas of the economy, together with maximum exploitation of the advantages of gas over other fuels.

The rational use of gas is one of the factors of technological progress in modern industry.

3.3. In order to meet the growing demand for gas in various spheres of consumption a number of countries are establishing priorities for gas supply.

It is a generally recognized principle that gas is supplied first of all to the sectors of the economy that are best able to make use of it, i.e. to those in which its advantages (the efficiency of gas-fired plant, controlled combustion, purity of the combustion products etc.) are most fully exploited.

There is a general tendency to cut back on the use of gas for electricity generation [22]. The need to maintain a constant load on the gas-distribution grids however, has to be taken into consideration when gas consumers are being decided upon, in other words the variation over time in the amount of gas used by each individual consumer has to be allowed for and regulated.

Gas tariffs should contribute to the solution of these problems.

3.3.1. In the USSR, including the Byelorussian SSR and the Ukrainian SSR, which use a common methodological approach, a system of indicators has been established in the form of a "Scale of efficiency of gas use", in which consumers are ranked according to the effect of reducing the unit consumption of fuel (by comparison with other forms of energy), the reduction in capital and operating costs, and other indicators. The system takes into account the level of domestic and industrial comfort and reduction of air pollution. Domestic and municipal consumers are the priority consumers, followed by consumers using gas as a raw material in the chemical industry for the synthesis of ammonia, methanol, carbon black etc. Boiler power stations are last on the "Scale of efficiency", although power stations in large industrial centres may be supplied with gas in order to avoid air pollution.

3.3.2. In the United States of America consumers are divided into nine categories for purposes of priority of service. The satisfaction of domestic consumers and their requirements is given the highest priority, while the boiler fuel use of gas is in the lowest category.

3.3.3. Preference is given in Hungary to enterprises using gas with a highly stable consumption level (max/min = 1.0 - 1.1), also to consumers whose use of gas results in a cut-back in unit energy consumption (manufacture of ceramics, the glass industry, bakeries, etc.), i.e. preference in the allocation of gas between the sectors of the economy is given to the general rationalization of energy consumption. Domestic use is regarded as the most important element in gas consumption.

Gas consumption in 1973 was as follows, in percentages: 93 in industry, 1 in agriculture, and 6 for domestic use.

Consumption of natural gas in Hungarian industries in 1973 was as follows, in percentages: 21.5 in the chemical industry, 17.0 in the metallurgical industry, 8.0 in the building materials industry and 28.0 in power generation.

3.3.4. The following order of priority has been set for the supply of natural gas in the German Democratic Republic, having regard to the special features of the country's energy supply (use of town gas and of natural gas with a high inert content):

As raw material in chemical production

For high-temperature processes (glass and ceramics industry, etc.)

Urban gas supply.

4. The main trends in the rational and economical use of gas to ensure a reduction in unit energy consumption are as follows:

4.1. Use of the heat of waste gases, both directly in the process plant (e.g. for pre-heating the combustion air) and in order to produce thermal energy and electric power. The use of recuperators, for example, yields a 15 per cent fuel saving in Switzerland. In the USSR, including the Ukrainian SSR, extensive use is made of water-evaporation cooling of high-temperature furnace elements, the steam thus generated being used for power production and in technological processes.

Since installations using the heat of waste gases (recuperators, waste-heat boilers) are relatively costly, no use at all is made of heat recovery in many gas-fired installations. The recent change in fuel prices will stimulate the use of up-to-date design solutions, including heat-recovery equipment.

4.2. Elimination of the need for intermediate heat carriers in the production cycle. Gas in the required amounts may be used both by gas motors and turbines, and by heating equipment, furnaces, driers and the like. Such is the universality of natural gas as a fuel that it is widely used in independent assemblies for the direct heating of work-pieces or materials [24]. Thus, mention should be made of gas combustion in what are known as submerged burners, in which the heat obtained from combustion of the gas is imparted directly to the fluid to be heated by bubbling the combustion products through it. Assemblies of this kind are used to heat water, solutions, and molten salts and metals.

The use of gas radiant tubes instead of electric heaters for the heat treatment of metal, and use of the combustion products of natural gas instead of water vapour for the heat treatment of reinforced concrete elements, reduces fuel consumption by a factor of 1.5 and yields a high quality product. The substitution of gas-air heaters and gas-fired infra-red radiators for hot water or steam, for heating industrial buildings, saves fuel by reducing heat loss in the heat-distributing pipelines and makes possible more flexible adjustment of the heat supply.

4.3. The extensive use made in the USSR, including the Byelorussian SSR and the Ukrainian SSR, of the heat from electric power stations for central heating in towns reduces fuel consumption for electricity and heat generation and increases the over-all efficiency of fuel utilization.

4.4. The integrated and multistage utilization of the heat obtained from the products of the combustion of natural gas (energy cascade). The method makes successive use of the combustion products as a heat-carrier in units functioning at different temperatures - high, medium and low. Thus the heat of escaping flue gases is used in place of steam and electric power to dry textiles, to season timber and to heat greenhouses, hot-houses, etc. [25].

In agricultural production, gas is used extremely effectively for space heating, as a plant nutrient in the form of carbon dioxide, and for the storage of agricultural produce in gas media, obtained from the combustion of natural gas.

The use of the combustion products from a number of industrial plants to supply heat and carbon dioxide to nearby farms with hot-houses and hotbeds gives very good results. The compressor stations of gas pipelines are one such very promising source.

The introduction of systems for the multistage use of the heat of waste gases must be preceded by a technical and economic study of various alternatives, based on a number of factors.

4.5. Use of steam-gas circuits for power generation, as well as use of what are known as gas fired universal power installations, designed to provide an independent electrical and thermal energy supply for enterprises situated far from industrial centres [24]. These plants are equipped with gas engines or gas turbines that drive electric generators.

4.6. The following are generally recognized methods of reducing unit consumption of gas and effecting economies:

4.6.1. The development and use of modern equipment with highly efficient heat insulation and automatic control to ensure that the plant operates at the optimum load and to avoid the unproductive combustion of gas.

4.6.2. The development and use of modern burners with automatic systems for the control and regulation of combustion processes, the use of special burners with automatic recuperation and adjustable flame characteristics, the use of high-temperature radiation equipment, etc.

4.6.3. The use of the latest methods of measuring and calculating gas consumption and of monitoring the temperature and composition of waste gases.

4.6.4. Optimization of the thermal operation of gas furnaces through the use of burners with adjustable flame length, the use of electric-arc heating, and the use of forced-blast oxygen and heated air from optimum arrangements of burner units.

4.6.5. Space heating in industry and agriculture by the direct heating of the air by infra-red radiation burners.

4.6.6. Improvement in the heat insulation of buildings and dwellings, and automation of the supply of heat for heating purposes.

5. The rational and economic use of gas is one of the main aims of the energy policy being pursued by the Member States of the United Nations Economic Commission for Europe. The experience built up by countries makes solution of the problem of the economic use of gas in various sectors of the economy a real possibility. In most of the countries, a regular analysis of the position is made, the existing technological level of gas utilization is assessed, and programmes are devised for increasing the efficiency of gas use by ways including the solution of economic, organizational and technical problems.

5.1. In Belgium, the rational use of gas is achieved by channelling the availabilities, so far as possible, towards uses in which the specific properties of this form of energy are most effectively utilized. When implementing measures aimed at saving energy and combating environmental pollution, the use of natural gas has been found particularly advantageous in the following cases: Individual household heating; direct heating of air; production of hot water by burning gas beneath a layer of liquid; combined steam-gas circuits; and for producing reducing gases in iron and steel metallurgy. The efficiency of the use of gas in the various sectors is determined by the benefits accruing to the consumer - both direct benefits and "spin-off" (improvement of product quality; of working conditions; of productivity; etc.).

5.2. In Hungary the rational use of gas is controlled by the competent authorities and is governed by the Gas Law. The National Energy Council issues permits for the use of gas and, should an application be refused, recommends some other fuel.

Distribution of natural gas consumption among the various sectors of the economy is laid down by the national five-year plans and forms part of what is known as the Gas Programme, a centrally directed national plan for the distribution and use of gas. The Gas Programme is approved by the Government for a period of five years. There is an interdepartmental Committee for implementing the Programme.

5.3. In the German Democratic Republic matters to do with the rational use of gas are dealt with on a nationwide basis, the aim being to conserve primary energy and reduce energy conversion losses in the economy as a whole, and to increase the productivity of technological processes (by comparison with the use of other fuels) while allowing for the environmental effect. The power supply undertakings and the local authorities have the requisite powers and rights of inspection.

When the gas use situation is being analysed a comparison is made of the unit consumption of gas (energy). Unit consumption is affected by the technology employed, and by the quality of the equipment and its operation. Optimization depends upon those factors. Standards for gas consumption, which are updated in the light of technical progress, are set by evaluating a process's unit consumption.

The manufacture of municipal and domestic gas appliances is subject to standards in regard to, among other things, minimum energy efficiency.

The specific gas consumption of industrial installations and the efficiency of domestic appliances are periodically compared with similar indicators for equipment in other countries.

5.4. In Ireland, efficient use of liquefied petroleum gas in industry and in the municipal and domestic sector is monitored by consultants. The consultants' aid programme is run by a governmental agency.

5.5. In Canada a check on the efficiency of fuel economy measures has revealed a reduction in average fuel expenditure resulting from the heat insulation of buildings and the use of a lower night-time temperature setting and improved burners [26].

5.6. In the Netherlands rational energy use policy is directed towards employing processes and instruments with optimum natural gas consumption, as well as improving thermal insulation in industrial premises and dwellings.

A new series of boilers is going into operation to provide high efficiency central heating and hot water. The boilers are designed to ensure cooling of the waste gases to the temperature of the water entering the boiler. According to the company "Gasuni", over-all efficiency is 86-96 per cent at higher combustion heat.

5.7. In the United Kingdom, for purposes of determining the efficiency of gas use not only high efficiency is taken into account but also other factors which are of great importance: the possibility of process control, the quality of the output, reduction of the number of rejects, increased productive capacity, reduced expenditure on fuel transportation, better working conditions. reduction of environmental pollution, and considerations of capital expenditure and running costs.

The national price indices and the cost of supplying the various types of fuel are taken account of when the rational and economic use of gas is being decided upon.

Considerable efforts are being made in the United Kingdom to increase the thermal efficiency of domestic and industrial appliances (e.g. automatically recuperating burners).

5.8. In the USSR, including the Byelorussian SSR and the Ukrainian SSR, there is a State system for the distribution and efficient use of gas, directed by the USSR Ministry of the Gas Industry and the Gasification Boards of the Union Republics. Research organizations analyse the situation as regards gas use, develop technical solutions, and draft proposals for increasing efficiency. The State Gas Inspectorate monitors the economic use of gas by consumers. The indicators of the level of efficiency of gas use are the unit consumption and efficiency of gas-fired installations, productivity and working conditions, and capital investment and running costs in relation to the end product (due regard being paid to product quality, the amount of rejects etc.).

5.9. In the Federal Republic of Germany an energy economy law has been passed to control losses in air-conditioning and space heating, and requirements have been laid down for better heat insulation of buildings, as well as more stringent requirements concerning the equipment of heating and conditioning systems.

Suitable steps are being taken to conserve energy, to maintain industrial investment by means of financial and tax measures, to inform consumers, and to promote research on rational energy use and conservation.

5.10. In France, measures are being taken to conserve energy in municipal and domestic consumption through the development of individual gas-fired central heating, automatic control of heating installations and improved heat insulation of buildings, and elimination of the least warranted forms of gas use.

In industry the object of the economy measures being taken is to make gas available for process use or as a raw material, also to extend and recast the pattern of gas users with a view to ensuring requisite flexibility in the event of technical failures in supply. Gas suppliers give consumers technical help over saving gas.

Advertising that encourages energy consumption and pronouncements advocating the use of energy and detailing its advantages are prohibited.

The Government is allocating 150 million francs in subsidies to industry for the production of fuel-saving plants. One billion francs are available in the form of long-term credits for projects to increase fuel use efficiency [27].

5.11. In Switzerland the aims of the gas industry are to promote methods for the use of gas that will ensure a reduction in unit consumption and a high level of comfort and of product quality.

It is considered appropriate to use gas appliances for space heating (for industrial premises, hot-houses and hotbeds), and to use gas-fired infra-red panels (for large industrial premises).

It is recommended that use should be made of submerged burners (e.g. for water heating) and radiant tubes, and that heat recovery from waste gases should be widely applied.

Heat pumps are considered promising.

6. Conclusion

The information submitted by Governments shows that the rational and economic use of gas is one of the main aims of the energy policy of European countries and that much relevant experience has been acquired.

Programmes to increase efficiency in the use of gas, involving solutions to economic, organizational and technical problems, are being carried out in some countries.

The present investigation may be continued with the object of examining and disseminating each country's experience in the economic and effective use of gas.

Table 1

CONSUMPTION OF NATURAL GAS AND ITS SHARE IN THE FUEL AND ENERGY BALANCE

Country	1975-1976		2000 (forecast)		Notes
	Consumption billion m^3	Percentage of fuel and energy balance	Consumption million TCE	Percentage of fuel and energy balance	
United States [6,7,8]	545	28	725	12.1	
USSR [9]	285.9	21.8			
United Kingdom [7,8,10]	55*	16	50	14.5	*Million TCE
Germany, Federal Republic of [8,11,12]	48	14	80	10.3	
Netherlands [7,13,14]	44*	43		4	*1976 production 96 billion m^3, 54 per cent exported
Canada [8,11,14]	62*	26	131	20.2	*1976 production 89 billion m^3, 30.4 per cent exported
France [4,8,12]	23	10	60	10.3	
Japan [7,8,15,16]	2.8 * 5 **	2	125	10.4	*home production **imported LNG

Table 2

BREAKDOWN OF THE CONSUMPTION OF NATURAL GAS, 1975-1976 PERCENTAGES

Sectors	United States* [6]	USSR* [9]	Germany, Federal Republic of* [19]	Canada* [11]	France* [20, 21]
Electric power generation	16	26.8	29.1		14**
Industry: of which:	43	55.4	51.6	55	45**
chemicals	10.2	8.5	14.6		16.5
metallurgy	6.0		19.3		
Iron and steel		12.5			5.1
non-ferrous		2.1			0.5
mechanical engineering and metal-working		8.8			6.8
building materials		8.2	1.6		10.3
oil and gas	7.0	8.0			
light industry	2.4	1.2			1.8 (including paper industry)
food industry	2.5	2.8			1.6
other sectors	14.9	3.3	16.1		2.4
Municipal and domestic	41	14.2	12.9	45 (23 per cent utilities, 22 per cent municipal consumers)	41**
Others			6.4		

Notes: *In 1976 (United States); *In 1976 (USSR); *Gas distribution (including natural gas) in 1975 (Germany, Federal Republic of); *In 1975 (Canada); *In 1975, **1974 figures (France)

ANNEX

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